REMARKS

By the present amendment, claims 1 to 6 are pending in the application. Claim 1 is the only independent claim.

Claim Amendments

Claims 1 to 6 have been amended to change "metallic product" to read --steel product--. Support for --steel product-- may be found in the specification, e.g., at page 4, lines 26 to 30; page 11, lines 8 to 13; and page 11, lines 14 to 19.

In claim 1, paragraph (2), the phrase "at a low temperature" has been deleted in response to a rejection under 35 U.S.C. §112, second paragraph.

Amendment To Title

The Title of the invention has been changed by deleting "metallic product" and inserting --steel product--.

§112, ¶2

Claim 1 was rejected under 35 U.S.C. §112, second paragraph, as being indefinite. The Office Action objected to the term "low" in paragraph (2) of claim 1.

By the present amendment, the phrase "at a low temperature" has been deleted from paragraph (2) of claim 1.

In view of the present amendment, it is respectfully requested that the rejection of claim 1 under 35 U.S.C. §112, second paragraph, be withdrawn.

§103

Claims 1 to 6 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,338,765 to Statnikov (the " '765 patent") in view of Lu (Materials Science and Engineering, R16 (1996) pp 161-221).

This rejection is respectfully traversed.

The Present Invention

The present invention provides a method of production of a steel product with a nanocrystallized surface layer by means of, in combination, an amorphous state surface layer created by ultrasonic impact treatment and heat treating this surface layer at an appropriate temperature of e.g., 100 - 500°C, for obtaining a nanocrystallized surface layer, said method of production of a steel product with nanocrystallized surface layer characterized by comprising;

(1) subjecting a surface layer of a steel product to ultrasonic impact treatment impacting it by one or more ultrasonic indenters vibrating in a plurality of directions, then

(2) subjecting the surface layer subjected to the ultrasonic impact treatment to heat treatment to cause precipitation of nanocrystals.

Patentability

The '765 patent only discloses ultrasonic impact methods for treatment of welded structures or creating a white layer (amorphous layer) at the welded portion. The white layers are on the treated body surface and in a narrow under-surface layer, typically one micron thick for reduction, elimination, redistribution, and/or relaxation of tensile stresses and for treating defective structures such as voids and grain structures weakening the internal body structure including residual welding stresses.

However, the '765 patent does not disclose or suggest the characteristic feature of the present invention, which has a nanocrystallized surface layer, and the formation of nanocrystallized surface layer by the steps defined in the production process as claimed in claim 1.

Lu discloses that polycrystalline materials with nanometer-sized grains, termed nanocrystalline materials, can be formed by crystallizing completely amorphous

solids under proper heat treatment (annealing) at an appropriate temperature (about Ta/Tm - 0.5). However, the resultant material obtained by Lu has a nanocrystallized structure in the entire thickness of bulk material. There is no disclosure or suggestion in Lu of how to obtain a nanocrystallized surface layer on a steel product. This means that Lu only discloses that the nanocrystallized structure can be obtained by annealing an amorphous phase of Fe-base alloys to form a nanocrystallized bulk material. However, Lu does not disclose or suggest a steel product having a nanocrystallized surface layer formed by ultrasonic impact treatment of the surface and annealing of this surface layer.

Therefore, the '765 patent in view of Lu do not disclose or suggest the characteristic features of the present invention.

It is therefore submitted that independent claim 1, and claims 2 to 6 dependent thereon, are patentable over the '765 patent in view of Lu.

CONCLUSION

It is submitted that in view of the present amendment and foregoing remarks, the application is now in condition for allowance. It is therefore respectfully requested that the application, as amended, be allowed and passed for issue.

Respectfully submitted,

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